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ABSTRACT

Although small, high-technology firms contribute greatly to major scientific and technical innovations, their potential impact is hindered by financial, personnel, regulatory and other problems. In 1977, the National Science Foundation conducted a survey of firms (N=1,232) presumed to be active in research and development (R&D) and sponsored several in-depth follow-up interviews of company executives (N=71) to better assess the nature and extent of these problems. Eleven problem areas were identified. An underlying factor in most of these was lack of funding. More than half of the surveyed firms indicated that each of the problems (except patenting and licensing) was of major concern. Four areas were identified as major concerns by two-thirds of the firms: providing competitive salaries and benefits, maintaining R&D work at adequate levels, dealing with procurement regulations, and obtaining venture and/or working capital. The appendices provide technical notes, statistical tables, and the survey instruments from the study. (DC)

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problems of small, high-technology firms

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foreword

Survival and growth of the small, high-technology firm have been issues of ern to technology planners since the late forties. It is widely held that the United S. tes' position of world leadership in high technology has been significantly furthered by the innovativeness and entrepreneurship of small companies. Over the past thirty years, however, changes in economic and governmental policies and practices have had a significant effect on the growth and survival of this sector.

In the seventies, the small-business community and the Federal Government sought to identify the factors responsible for a gradual weakening of the small-business community and to make changes in financial, tax, and procurement regulations needed to revive and renew growth of the Nation's small businesses. Toward this end, conferences were organized and studies were initiated to investigate problems and to recommend solutions. None of these efforts, however, concentrated on small, high-technology firms or on the problems of special concern to this group. A small group of high-technology firm executives cited several serious difficulties, but no data existed to demonstrate how pervasive these problems were.

In order to partially fill this information gap, the National Science Foundation (NSF) undertook in 1977 a survey of almost 13,000 high-technology companies which were believed to be active in research and development; each had fewer than 500 employees. The survey was followed in 1979 by a series of in-depth interviews, conducted by Economic Associates, Inc., under contract to NSF. This report summarizes the findings of the survey and of the subsequent interviews. It systematically confirms the existence of most of the problems previously confined to random anecdotes. It further assesses the extensiveness of these problems among various subgroups of high-technology firms. As such, it has established a firmer basis for planning and policy development.

NSF gratefully acknowledges the cooperation of the numerous organizations that contributed to this study.

Charles E. Falk
Director, Division of Science
Resources Studies
Directorate for Scientific, Technological,
and International Affairs

December 1981

notes

This report is based on a mail survey conducted by NSF near the end of 1977. Of the 13,000 questionnaires mailed to firms in the United States believed to be engaged in R&D activities, there were 1,232 usable responses. The primary criterion for inclusion in the survey was the number of employees of each company in 1976—fewer than 500 for manufacturing firms and fewer than 100 for nonmanufacturing firms. The survey was followed by a series of in-depth interviews in 1979 of 71 of the participating firms.

Various overall industry expenditure and personnel data cited in the text and charts are based on 1971 and 1976 data from the annual NSF survey of research and development in industry. The data are shown to provide perspective on the level of activity in small, high-technology firms relative to all R&D-performing companies. The latest year for which such data are available for small firms is 1976.

acknowledgments

This report was prepared by William L. Stewart, Head, and Norman W. Friedman, Staff Associate, R&D Economic Studies Section, Division of Science Resources Studies. Thomas J. Hogan, Study Director, Industry Studies Group, and Margaret R. Grucza, Carolyn B. Arena, and Mary V. Burke, also of the Industry Studies Group, helped interpret the data.

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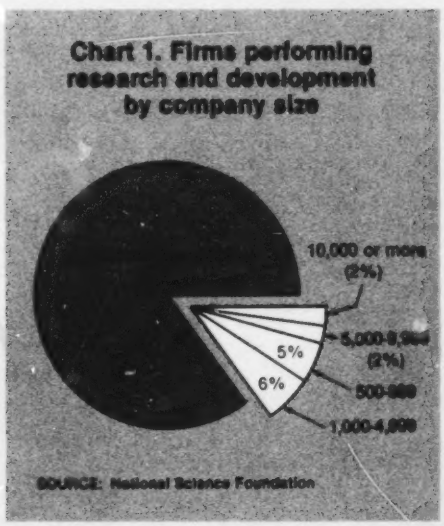
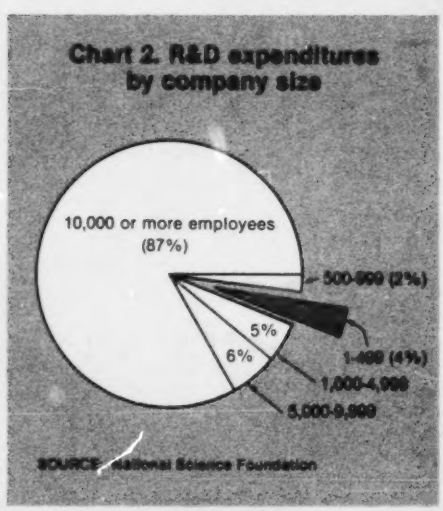
introduction

The small, high-technology firm is an important resource for major scientific and technical innovations. A number of studies have pointed out that small companies may produce major innovations more efficiently than large companies. Independent inventors and small, high-technology companies have been responsible for a much larger percentage of important innovations than their relatively small investments in research and development (R&D) activities would suggest.[1] According to estimates provided NSF by the Bureau of the Census, 13,000 small firms in the United States engage in research and development either as a primary activity or as a means of maintaining competitive status. These small firms represent 85 percent of all firms carrying out research and development, account for 4 percent to 5 percent of the total R&D dollars spent by industry, and employ about the same proportion of industry's R&D scientists and engineers. They receive only about 2 percent of the total Federal funds allotted to industry for research and development, however, and contribute, overall, about 4 percent of their own funds to these activities (charts 1-5).[2]

While all firms can have financial, personnel, and regulatory problems, such problems often have a more serious impact on the small, technically oriented firm. By definition, small firms cannot draw on income from large-scale manufacturing or marketing to sustain significant R&D efforts. Furthermore, the high risk often associated with

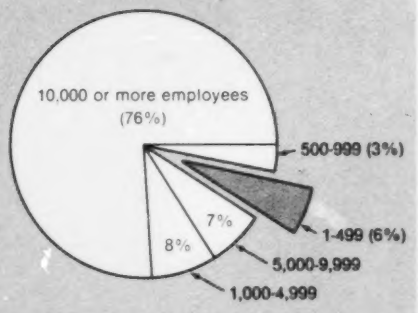




[1] J. Jewkes, D. Sawers and R. Stillerman, *The Source of Invention*, 2nd ed. (New York: W.W. Norton, 1969); M.J. Peck, "Inventions in the Post-War American Aluminum Industry" in the *Rate and Direction of Inventive Activity: Economic and Social Factors*. (Princeton, New Jersey: National Bureau of Economic Research, 1962).

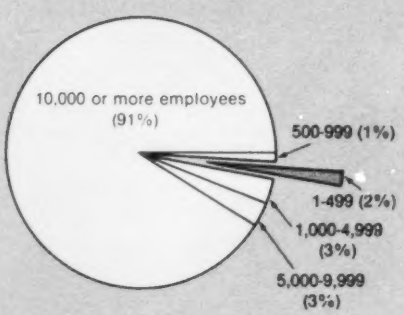
[2] Based on data from unpublished tabulations prepared by Bureau of the Census from the 1971 and 1976 National Science Foundation surveys of research and development in industry.

Chart 3. R&D scientists and engineers by company size



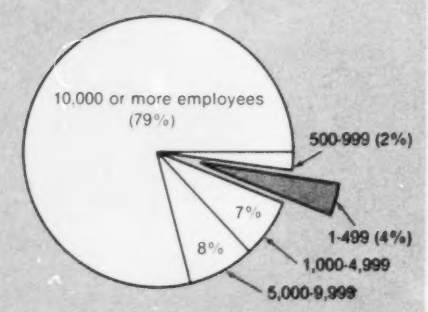
SOURCE: National Science Foundation

Chart 4. Federal R&D expenditures by company size



SOURCE: National Science Foundation

Chart 5. Company R&D expenditures by company size



SOURCE: National Science Foundation

research and development makes these firms less attractive to public financing sources except in those relatively rare instances when the investors sense unusual growth possibilities. Limited financial resources make it difficult for small firms to compete with large firms for scientific and technical personnel and make dealing with government regulations a special problem.

This report summarizes the findings of 1,232 responses to an NSF survey of small high-technology firms and a series of followup, in-depth interviews of company executives of 71 of these firms. (See Technical Notes on Survey Methodology.) While an attempt was made in both the survey and the interviews to include firms in all major industries, by size of firm, the information collected was not intended to be statistically representative of the universe.

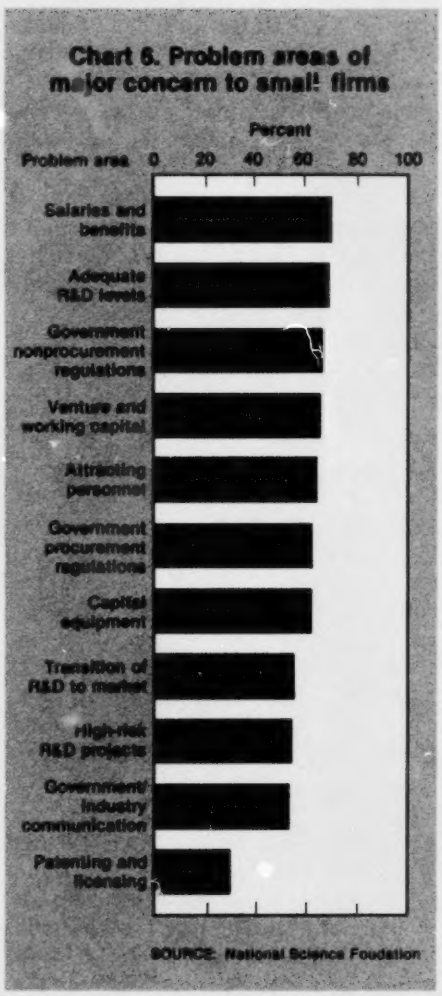
All small, high-technology firms are, of course, not the same. The types of problems and the effects of these problems on small firms vary with size (ranging from fewer than 20 to almost 500 employees), type (manufacturing or nonmanufacturing), form of ownership, and age. Often the effect of these differences is masked when firms are discussed in general terms. While this brief report allows only limited reference to these differences, their existence should be kept in mind. For example, the overall results of this survey are strongly influenced by the disparity in size of the 1,232 responding firms: 10 percent had more than 100 employees, while 56 percent had more than 20. While the over-100 group represents only 10 percent of the respondents (all in manufacturing), they account for 60 percent of the R&D expenditures of all small R&D-firms.

major problem areas

The NSF study identified 11 problem areas and asked small, high-technology firms to indicate a high, medium, or low level of concern in each. For this analysis, the medium and high levels of concern were combined into the single level, "major concern" (chart 6).

The 11 problem areas have been grouped into four broad categories:

- **Financial**
  - — Maintaining adequate R&D levels
  - — Obtaining venture and/or working capital
  - — Purchasing capital equipment
- **Personnel**
  - — Providing competitive salaries and benefits
  - — Attracting and keeping necessary personnel
- **Government Regulations**
  - — Dealing with nonprocurement regulations
  - — Dealing with procurement regulations
- **Other Problem Areas**
  - — Making the transition from research and development to marketing
  - — Undertaking high-risk R&D projects
  - — Government/industry communication
  - — Patenting and licensing



The lack of adequate funds appears to be an underlying factor in most, if not all, of the problem areas. For example, small firms with sufficient funds could offer more competitive salaries and benefits, and delays in their receiving government payments would be less critical. To attribute all of the problems to financial difficulties alone, however, would be simplistic and would provide a limited view of the problems faced by small, high-technology firms.

overall perspective

With the exception of patenting and licensing, each of the eleven problem areas was identified as being of major concern by more than 50 percent of the firms surveyed; seven areas were identified as major problems by more than 60 percent. Two-thirds of the firms identified four areas as major concerns: providing competitive salaries and benefits; maintaining R&D work at adequate levels; dealing with nonprocurement regulations; and obtaining venture and/or working capital.

financial problems

maintaining adequate r&d levels

Uncertainty whether funding would be sufficient and regular enough to maintain an adequate level of R&D activity was reported as a major concern by over 68 percent of the firms surveyed. The problem was of greater importance to manufacturing firms, particularly those involved in making instruments and electrical machinery, and of somewhat lesser concern to nonmanufacturing firms.

Manufacturing firms depend upon research and development to maintain their competitive positions in the market. Nevertheless, company officials note that when cash flow from product sales becomes barely sufficient to cover production and marketing expenses, the R&D budget, usually considered a soft budget area, often gets cut.

While all firms reported concern with maintaining adequate R&D levels, the level of concern tended to increase as size of firm decreased. Small firms are more sensitive to fluctuations in Federal funding, both directly and indirectly (when their clients are affected), and they have more difficulty making the necessary adjustments. Interviews with company officials reveal that the smaller the firm, the more cautious it tends to be in spending funds on research and development, particularly as the ratio of company expenditures to net sales increases.

obtaining venture and/or working capital

Obtaining venture and working capital was reported as a major concern by 66 percent of the responding firms. In a tight-money economy with interest rates rising, small companies are more vulnerable than large companies to discriminatory lending practices, and they suffer more from the unavailability of loans and increased costs of credit. The problem seems to be particularly acute among firms with fewer than 20 employees and among firms getting started or in the first years of operation. According to officials of small firms, the problem becomes less acute once the early difficult years have passed, although the cost of obtaining capital still remains highest for the smallest firms.

This was a significant problem area for both manufacturing and nonmanufacturing firms but more so for the latter, probably because they include most of the smallest firms in the survey. Firms which were especially concerned were business service firms, engineering and architectural firms, and R&D laboratories among the nonmanufacturing companies; and fabricated metal products, and instruments and electrical machinery firms among the manufacturing companies.

The severity of this problem and its relative importance among the major problem areas are probably understated since the survey did not include data from firms that had been forced out of business when they were unable to obtain capital.

purchasing capital equipment

Overall, 62 percent of the firms surveyed reported this as a major area of concern. Although a larger number of manufacturing firms (69 percent) were concerned with purchasing equipment, 56 percent of the nonmanufacturing firms also reported it as a problem.

Firms were concerned about the adequacy of depreciation allowances and other tax benefits as well as their ability to obtain necessary capital for equipment purchases. The high cost of capital equipment compared to small-scale profits was a primary reason for this concern. Some firms commented that the Federal Government was not treating them as favorably as prime corporations and universities, which are given Federal surplus or equipment purchased by the Government.

These concerns did not seem to be related to age, size, or type of firm. The proportion of all firms reporting this problem area as a major concern ranged between 68 percent and 71 percent for manufacturing firms, and between 52 percent and 57 percent for nonmanufacturing firms.

personnel problems

providing competative salaries and benefits

The ability to provide competitive salaries and benefits was reported as a major concern by more of the firms surveyed (69 percent) than any of the other problem areas. Small, high-technology firms allocate a high percentage of their R&D budgets for salaries and related personnel costs. During periods of inadequate cash flow, however, salaries and benefits offered to employees may not be competitive. Thus, the larger firm has an advantage in competing for and retaining skilled personnel. To compensate, some small firms offer generous inducements in the form of stock options, bonuses, liberal publication policies, and relatively long vacations, while others rely on part-time scientists and consultants. Some firms depend on their work being interesting enough to attract highly skilled specialists; others tempt scientists and engineers with opportunities to pursue research in areas in which they are particularly interested.

While the problem of providing competitive salaries and benefits affects firms of every size, age, type of ownership, and type of product, some seem to feel the problem more acutely than others. Over 75 percent of manufacturing firms, compared to 64 percent of nonmanufacturing firms, listed the

problem as a major concern. Over 70 percent of public and private corporations reported competitive salaries and benefits as an area of major concern. The problem seemed to be less of a concern to firms under sole proprietorship and partnership (51 percent). This problem area was particularly important to R&D laboratories, instrument manufacturers, and electrical machinery and engineering service firms.

Some firms felt that the Government's slow response in paying for services rendered, the Government's ceilings on consultant's pay, and the fluctuation of business activity were largely responsible for their problems in remaining competitive with the salaries and benefits offered by larger industries and the Federal Government. Business fluctuations are perhaps the most critical element since a small firm with limited resources often has difficulty maintaining the workload necessary to support salaries and benefits, maintaining operating facilities, and procuring additional work.

attracting and keeping necessary personnel

Turnover of personnel is often high. Small firms undertake many short-term projects, and their reserves are usually insufficient to maintain staff during slack periods. This unstable employment environment also acts as a barrier in recruitment. Attracting and keeping personnel is a problem for small firms regardless of size. But the problem was reported as a major concern mostly by firms with over 100 employees (82 percent). The problem was of less concern to younger firms than to older firms. Two explanations have been offered by respondents for the smaller percentages of the smallest and youngest firms reporting this problem. First, the small or young firm may be staffed by the original employees who have a personal commitment to the success of the firm and therefore may be less likely to leave. Second, many of the smallest or youngest firms are less well established and therefore may be more concerned with survival—acquiring capital and sustaining R&D activity—than with personnel matters.

government regulations

dealing with nonprocurement regulations

While all businesses must deal with government regulations, the small firm has fewer resources to cope with the paperwork, the intricacies of regulations, and the effort of keeping up-to-date with changes and new developments. The widespread impact of problems with nonprocurement regulations is compounded by the number of Federal, State, and local agencies issuing regulatory requirements and the number and diversity of forms which must be completed.

Dealing with nonprocurement regulations was listed as a major concern by 66 percent of the firms surveyed. Both manufacturing and nonmanufacturing firms reported the problem as a major concern, but larger firms in both groups indicated the greatest concern. Public corporations reacted most strongly (76 percent), but private corporations (67 percent) and sole proprietorships and partnerships (58 percent) were also significantly affected. Although small, high-technology companies, no matter when established, reacted strongly to this question, the youngest firms seem to be the most adversely affected.

Of the industry groups, 84 percent of responding chemical manufacturers reported this problem as a major concern, which appears to confirm the findings of a 1979 study citing the chemical industry as among those most affected by Federal regulations.[3] Sixty-eight percent of R&D laboratories, the largest industry group in the survey, also reported this problem as a major concern. For the other industries, the percent ranged from 51 to 71, confirming the significance of this area as a pervasive small business problem.

dealing with procurement regulations

While government nonprocurement regulations affect all firms to some degree, procurement regulations also affect those doing business with any level of government. The number and complexity of procurement regulations tend to deter small firms from seeking government contracts for research and development.

Sixty-two percent of all responding firms listed this problem as a major concern. Nonmanufacturing firms (67 percent) appeared to find dealing with procurement regulations more of problem than manufacturing firms (55 percent), although the latter group did not consider the problem insignificant. As a separate group, nonmanufacturing firms listed the problems as second in importance among the 11 problem areas; subgroups such as R&D laboratories and management and business services listed it as first. Overall, manufacturers listed the problem as ninth in importance.

This problem area was of concern to firms regardless of type of ownership. The larger the firm, the more important the problem area seemed to be, but again only in a relative sense, since over 50 percent of the firms, regardless of size, rated it as being of major importance.

Firms reported as concerns some of the problems cited in the previous section on nonprocurement regulations (the amount of paperwork and the different requirements of agencies and governments). Bidding procedures, award standards, and auditing and payment procedures and standards were also named as problems. Firm officials complained specifically about complicated and time-consuming proposal require-

[3] "The Cost of Government Regulation," a study for *The Business Roundtable*, (Washington, D.C.: Arthur Anderson and Company, March, 1979).

ments, unrealistically high qualifications for small business set-asides, favoritism toward larger firms and universities, discrimination against new firms, delays in making interim and final payments, and unreasonable accounting requirements

Small firms commented that, because of their problems in dealing with procurement regulations, they sometimes failed to get Federal contracts for which they felt qualified, and that when they did, the profit margin was inadequate for the work performed.

other problem areas

making the transition from research and development to marketing

Making the transition from research and development to marketing is a common problem for small, high-technology firms. The problem, however, apparently affects manufacturing firms and firms dealing largely with the commercial market more than nonmanufacturing firms and firms dealing with the Federal Government. Respondents mentioned inexperience with marketing and marketing research and the high cost of national advertising as underlying causes of the problem.

Marketing was apparently less of a problem among nonmanufacturing firms, which were generally more concerned with shortages of capital and government regulations.

The transition from research and development to marketing was cited by more public corporations (68 percent) than firms under other types of ownership (over 50 percent). The youngest firms (63 percent) and the larger companies registered the most concern, although this is a significant problem area for firms of all ages and sizes.

undertaking high-risk r&d projects

By definition, a given high-risk project is a larger proportion of the activity of a small firm than of a large firm. Therefore, the risk of failure, delay, or cost overrun, etc. for a small firm is greater for a given project. Undertaking high-risk R&D projects appeared to be a greater problem for manufacturing firms, principally nonelectrical machinery and instrument manufacturers, than for nonmanufacturing firms. Among nonmanufacturers, R&D laboratories, the largest single industry group responding to the survey, were the most affected. Over 50 percent of firms under all types of ownership saw this as a major problem, with public corporations (60 percent) more so than others.

Approximately 50 percent of the responding firms, regardless of when they were established, reported undertaking high-risk R&D projects as a major concern. Nonmanufacturing groups, regardless of size, were affected equally, with 50 percent of firms in each of the size groups listing the problem as a major concern. Among manufacturers, however, firms with 20 to 99 employees were affected most.

Small firms frequently are not capitalized sufficiently to undertake high-risk projects, even though the tasks might have large payoffs. Among those that are, some complain that large firms wait until the small firm has developed a successful product or service and then, when the high-risk period is over, move in, often driving the small firms out of business. Thus, the firms tend to concentrate on projects with short-term payoffs.

government/industry communication

Communication problems range from difficulties in finding information in the many Federal publications to difficulties in contacting knowledgable program representatives. Although this problem ranked only tenth, it is one that is frequently raised during discussions with small business managers. Its significance should not be lost because of its low relative ranking; over one-half the firms reported it as a major concern.

Among manufacturers it was of concern principally to producers of fabricated metal parts (57 percent) and chemical and allied products (56 percent). Among manufacturing firms, the larger ones were most affected (55 percent compared to 47 percent for the smallest firms).

In general, firms reported having difficulty obtaining information on project opportunities and proposal requirements. Person-to-person interaction with Government agency staff also appears to be a problem. Firms complained that they had trouble first identifying the person with the right information and then dealing with that person on a continuing basis. They also cited as problems the technical competence of agency staff and the lack of staff concern for the special problems of the small business.

patenting and licensing

Patenting and licensing ranked last among all the major problem areas, with 29 percent of the firms reporting it as a major concern. Overall, there was little difference between manufacturers and nonmanufacturers, although a large percentage of chemical and allied products and fabricated metal parts manufacturers registered concern. Fewer private corporations saw this as a major problem than did sole proprietorships, partnerships, and public corporations.

Although some smaller firms are dependent upon their patents and trade secrets, most seem to feel that patenting and licensing is a problem area that they have under reasonable control. According to officials interviewed, rather than pay the attorney fees to press patent infringement charges against large firms, for many years small firms have chosen to deal with the problem by selling ideas either outright or by merging with larger companies, or they just try to keep details of innovations secret.

appendixes

a. technical notes

b. statistical tables

c. reproduction of survey instruments

appendix a

technical notes

This report is based on data collected in a survey conducted by the National Science Foundation (NSF). The survey investigated the importance of significant problem areas faced by firms engaged in R&D activities during the year 1977. The survey covered only for-profit companies. Government-operated, nonprofit, and university organizations were excluded, as were small firms that failed and those that were affiliated with, or that were a part of, larger companies.

Since neither the universe of small R&D firms was known, nor their characteristics distribution, it was not possible to design a truly statistically representative sample of small R&D firms. Thus it was only possible to obtain informed opinion from as wide a grouping as possible on the problem areas that significanly affect firms engaging in R&D activities and to discover how important the firms consider these problems to their survival and success.

From October through December 1977, survey forms (appendix C) were mailed to nearly 13,000 firms believed to be engaged in R&D work, either company or otherwise sponsored. The survey covered only companies whose employment levels in 1976 was fewer than 500 in manufacturing firms and fewer than 100 in nonmanufacturing companies.

Three sources were used to develop a list of firms to be contacted. The principal source was the American Association of Small Research Companies which, under contract to NSF, provided a list of 10,300 firms. An additional list of 1,750 firms was provided by NSF. The mailing list was completed with the addition of some 700 company names obtained from the Office of Senator Edward Kennedy (D. Mass.). The postal authorities were unable to locate 5 percent of the companies on the first mailing list.

Questionnaires were returned by 2,955 firms for a 24-percent response rate. There was a usable response from 1,232 firms. These include returns by 530 manufacturing firms and 702 nonmanufacturing companies. Of the returns that were not usable, 931 firms indicated they did not perform research and development. Returns from the remaining 792 firms were not usable because their employment levels exceeded 500 employees or, in a few cases, firms classified for-profit were actually not for-profit organizations.

primary emphasis

The survey concentrated on problems of concern to the small, high-technology firms that have managed to stay in business.

The survey forms enabled respondents to indicate broadly how much concern or importance they attached to each specified problem area. Each firm was asked to note whether it considered a problem area to be of "high," "medium," or "low" concern. Some firms did not rank each problem area; among those that returned questionnaires the response rate varied from as low as 88 percent for the problem area of government/industry communication, to as high as 94 percent in the area of obtaining venture and/or working capital.

Throughout this report, problems of "high" and "medium" concern were combined, and for purposes of the survey constitute the major problem areas affecting the operations of the responding R&D companies.

characteristics of the survey participants

ownership

The 1,232 small R&D companies that returned usable questionnaires were from profit-making firms only. About 15 percent (181) were run by sole proprietors or partners. The remainder, 75 percent (1,051), were corporate entities, largely private corporations (table A-1).

age of firms

Nearly one-third of the companies have been in business for longer than 15 years. Forty-five percent were operating prior to 1967 (table A-2).

Table A-1. Ownership of firms: 1976

Type	Number of firms	Percent of total
Total	1,232	100.0
Sole proprietor	147	11.9
Partnership	34	2.8
Public corporation	137	11.1
Private corporation	914	74.2

Source: National Science Foundation

Table A-2. Firms by years in operation

Year formed	Number of firms	Percent of total
Total	1,232	100.0
1961 or earlier	400	32.5
1962-66	160	13.0
1967-71	339	27.5
1972-76	333	27.0

Source: National Science Foundation

The peak year of company formation was in 1970, when 98 firms were established. In 1972, a large number of new companies were formed (90), but since then, the number of companies being formed has decreased each year. In 1976, only 43 were started. This is the smallest number of firms starting in any year since 1968.

industry

The responding companies in 1976 were classified as manufacturing or nonmanufacturing industries according to the Standard Industrial Classification (SIC) product or service codes they reported. Accordingly, 43 percent, or 530 firms, were primarily manufacturers; some 57 percent, or 702 firms, were primarily nonmanufacturing industries (table A-3).

Table A-3. Respondent companies by SIC industry: 1976

Industry	SIC code	Number of firms	Percent of Industry	Percent of All respondents
Total	----	1,232	----	100.0
Manufacturing Total	----	530	100.0	43.0
Instruments; photographic, medical, and optical goods; watches and clocks	38	153	28.9	12.5
Electrical machinery and supplies	36	136	25.6	11.0
Chemical and allied products	28	57	10.8	4.6
Fabricated metal products except machinery and transportation equipment	34	56	10.5	4.5
Machinery except electrical	35	55	10.4	4.5
Eleven other SIC groups except 21, 22, 25, and 31	----	73	13.8	5.9
Nonmanufacturing Total	----	702	100.0	57.0
R&D and commercial laboratories	7391-7	342	48.7	27.7
Engineering, architectural, and surveying services	891	156	22.2	12.7
Management, consulting, public relations, and miscellaneous business services	7392-9	139	19.8	11.3
Sixteen other SIC groups	----	65	9.3	5.3

Source: National Science Foundation

size of firms

The survey elicited more response from the nonmanufacturing sector, which generally is characterized by a high proportion of very small firms. Using employment as a measure of firm size, there were 687 companies with fewer than 20 employees responding to the survey. This number represents more than one-half (56 percent) of all the respondent firms, three-quarters of them operating in the nonmanufacturing sector. In the employment-size class of 20 to 99 employees, there were 240 manufacturing firms and 187 nonmanufacturing firms (table A-4).

Table A-4. Size of company: 1976 (based on number of employees)

Industry and employee size class	Number of firms	Percent of	
		Industry	All respondents
Total	1,232	-----	100.0
Manufacturing			
Total	530	100.0	43.0
1-19	172	32.4	14.0
20-99	240	45.3	19.4
100-499	118	22.3	9.6
Nonmanufacturing			
Total	702	100.0	57.0
1-19	515	73.4	41.8
20-49	137	19.5	11.1
50-99	50	7.1	4.1

Source: National Science Foundation

r&d expenditures

Slightly more than one-half the responding companies provided information on their 1976 expenditures for research and development. These 642 companies spent $131 million. Of this amount, nearly 37 percent, or $48.3 million, came from company funds. The major share of R&D expenditures, some 52 percent, or $68.3 million, came from Federal sources. The companies also spent $1.8 million of State government funds and $12.6 million from other sources. In addition, the companies purchased $4.2 million of research and development from outside organizations.

appendix b

statistical tables

Characteristics and Problem Areas of Responding Firms

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Additional data may be found in: Frank Piovia, *Problems Facing Small Companies Performing Research and Development* (May 1979) prepared for the National Science Foundation; also *Current Problems Facing Small R&D Firms* (December 1979) prepared for the National Science Foundation.

Table B-1. Number of responding R&D firms by form of ownership

Form of ownership	Number
Total	1,232
Sole proprietorships	147
Partnerships	34
Private corporations	914
Public corporations	137

Source: National Science Foundation

Table B-2. Number of responding firms by year established

Year	Number of respondents
Total	1,232
1976	43
1975	61
1974	66
1973	73
1972	90
1971	68
1970	98
1969	77
1968	67
1967	29
1966	27
1965	46
1964	24
1963	22
1962	41
1961	36
Earlier	364

Source: National Science Foundation

Table B-3. Number of responding firms by employment size in 1976

Industry	Number of responding firms	Employment size
	172	1-19
	240	20-99
Manufacturing	71	100-199
	47	200-499
	515	1-19
Nonmanufacturing	137	20-49
	50	50-99

Source: National Science Foundation

Table B-4. Number of responding firms by problem area[1] and by degree of concern[1]

Problem areas	Number of responding firms	Degree of concern		
		High	Medium	Low
Attracting and keeping necessary personnel	1,150	414	385	351
Providing competitive salaries and fringe benefits	1,154	410	443	301
Maintaining adequate R&D projects	1,127	458	388	281
Undertaking high-risk R&D projects	1,103	443	224	436
Purchasing capital equipment	1,142	323	426	383
Obtaining venture and/or working capital	1,155	548	267	340
Patenting and licensing	1,105	129	233	743
Government procurement regulations	1,132	491	275	366
Other government regulations	1,122	498	321	302
Transition from R&D to market	1,093	358	330	404
Government/industry communication	1,089	302	350	436

[1]A total of 1,232 firms responded to the survey. This table gives the number of respondents who checked off each problem as being of "High," "Medium," or "Low" concern.

Source: National Science Foundation

Table B-5. Number and percent of the 1,232 responding firms by degree of concern and by problem area[1]

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	1,150	93.34	414	33.60	385	31.25	799	64.85
Providing competitive salaries and fringe benefits	1,154	93.66	410	33.27	443	35.95	853	69.23
Maintaining adequate R&D levels	1,127	91.47	458	37.17	388	31.49	846	68.66
Undertaking high-risk R&D projects	1,103	89.52	443	35.95	224	18.18	667	54.13
Purchasing capital equipment	1,142	92.69	323	26.21	436	35.38	759	61.60
Obtaining venture and/or working capital	1,155	93.75	548	44.48	267	21.67	815	66.15
Patenting and licensing	1,105	89.69	129	10.47	233	18.91	362	29.38
Government procurement regulations	1,132	91.88	491	39.85	275	22.32	766	62.17
Other government regulations	1,122	91.07	498	40.42	321	26.05	819	66.47
Transition from R&D to market	1,093	88.71	358	29.05	330	26.78	688	55.84
Government/industry communication	1,089	88.39	302	24.51	350	28.40	652	52.92

[1]A total of 1,232 firms responded to the survey. This table gives the number of respondents who checked off each problem as being of "High," "Medium," or "Low" concern.

Source: National Science Foundation

Table B-6. Number and percent of the 181 responding firms under proprietorship and partnership, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	155	85.63	42	23.20	32	17.67	74	40.88
Providing competitive salaries and fringe benefits	155	85.63	57	31.49	35	19.33	92	50.82
Maintaining adequate R&D levels	156	86.18	65	35.91	50	27.62	115	63.53
Undertaking high-risk R&D projects	157	86.74	59	32.59	35	19.33	94	51.93
Purchasing capital equipment	158	87.29	56	30.93	44	24.30	100	55.24
Obtaining venture and/or working capital	164	90.60	94	51.93	28	15.46	122	67.40
Patenting and licensing	152	83.97	31	17.12	33	18.23	64	35.35
Government procurement regulations	153	84.53	72	39.77	30	16.57	102	56.35
Other government regulations	149	82.32	69	38.12	36	19.88	105	58.01
Transition from R&D to market	149	82.32	54	29.83	42	23.20	96	53.03
Government/industry communication	148	81.76	51	28.17	42	23.20	93	51.38

Source: National Science Foundation

Table B-7. Number and percent of the 137 responding public corporations, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	133	97.08	50	36.49	53	38.68	103	75.18
Providing competitive salaries and fringe benefits	133	97.08	40	29.19	63	45.98	103	75.18
Maintaining adequate R&D levels	130	94.89	59	43.06	45	32.84	104	75.91
Undertaking high-risk R&D projects	129	94.16	61	44.52	21	15.32	82	59.85
Purchasing capital equipment	132	96.35	28	20.43	62	45.25	90	65.69
Obtaining venture and/or working capital	134	97.81	56	40.87	29	21.16	85	62.04
Patenting and licensing	130	94.89	16	11.67	29	21.16	45	32.84
Government procurement regulations	131	95.62	50	36.49	43	31.38	93	67.88
Other government regulations	132	96.35	82	45.25	42	30.65	104	75.91
Transition from R&D to market	132	96.35	42	30.65	51	37.22	93	67.88
Government/industry communication	129	94.16	41	29.92	38	27.73	79	57.66

Source: National Science Foundation

Table B-8. Number and percent of the 912 responding public corporations, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	860	94.29	320	35.08	300	32.89	620	67.98
Providing competitive salaries and fringe benefits	864	94.73	311	34.10	345	37.82	656	71.92
Maintaining adequate R&D levels	839	91.99	333	36.51	292	32.01	625	68.53
Undertaking high-risk R&D projects	815	89.36	321	35.19	168	18.42	489	53.61
Purchasing capital equipment	850	93.20	238	26.09	329	36.07	567	62.17
Obtaining venture and/or working capital	855	93.75	396	43.42	210	23.02	606	66.44
Patenting and licensing	821	90.02	81	8.88	171	18.75	252	27.63
Government procurement regulations	846	92.76	367	40.24	202	22.14	569	62.39
Other government regulations	839	91.99	366	40.13	242	26.53	608	66.66
Transition from R&D to market	810	88.81	261	28.61	236	25.87	497	54.49
Government/industry communication	810	88.81	209	22.91	270	29.60	479	52.52

Source: National Science Foundation

Table B-9. Number and percent of the 400 responding firms established before 1962, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	371	92.75	140	35.00	125	31.25	265	66.25
Providing competitive salaries and fringe benefits	371	92.75	138	34.50	139	34.75	277	69.25
Maintaining adequate R&D levels	364	91.00	138	34.50	133	33.25	271	67.75
Undertaking high-risk R&D projects	344	86.00	134	33.50	62	15.50	196	49.00
Purchasing capital equipment	369	92.25	96	24.00	154	38.50	250	62.50
Obtaining venture and/or working capital	366	91.50	133	33.25	79	19.75	212	53.00
Patenting and licensing	350	87.50	38	9.50	75	18.75	113	28.25
Government procurement regulations	348	87.00	134	33.50	83	20.75	217	54.25
Other government regulations	352	88.00	166	41.50	95	23.75	261	65.25
Transition from R&D to market	338	84.50	111	27.75	113	28.25	224	56.00
Government/industry communication	332	83.00	91	22.75	109	27.25	200	50.00

Source: National Science Foundation

Table B-10. Number and percent of the 160 responding firms established between 1962 and 1966, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	150	93.75	60	37.50	53	33.12	113	70.62
Providing competitive salaries and fringe benefits	151	94.37	59	38.87	65	40.62	124	77.50
Maintaining adequate R&D levels	149	93.12	68	42.50	43	26.87	111	69.37
Undertaking high-risk R&D projects	148	92.50	57	35.62	35	21.87	92	57.50
Purchasing capital equipment	150	93.75	41	25.62	60	37.50	101	63.12
Obtaining venture and/or working capital	151	94.37	70	43.75	41	25.62	111	69.37
Patenting and licensing	148	92.50	14	8.75	27	16.87	41	25.62
Government procurement regulations	154	96.25	58	36.25	46	28.75	104	65.00
Other government regulations	152	95.00	61	38.12	45	28.12	106	66.25
Transition from R&D to market	149	93.12	49	30.62	41	25.62	90	56.25
Government/industry communication	147	91.87	39	24.37	43	26.87	82	51.25

Source: National Science Foundation

Table B-11. Number and percent of the 339 responding firms established between 1967 and 1971, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	322	95.98	112	33.03	114	33.62	226	66.66
Providing competitive salaries and fringe benefits	327	96.46	116	34.21	126	37.16	242	71.38
Maintaining adequate R&D levels	315	92.92	122	35.98	110	32.44	232	68.43
Undertaking high-risk R&D projects	313	92.33	118	34.80	65	19.17	183	53.98
Purchasing capital equipment	317	93.51	87	25.66	117	34.51	204	60.17
Obtaining venture and/or working capital	321	94.69	162	47.78	71	20.94	233	68.73
Patenting and licensing	312	92.03	41	12.09	68	20.05	109	32.15
Government procurement regulations	322	94.98	144	42.47	80	23.59	224	66.07
Other government regulations	319	94.10	143	42.18	85	25.07	228	67.25
Transition from R&D to market	310	91.44	98	28.90	99	29.20	197	58.11
Government/industry communication	310	91.44	92	27.13	94	27.72	186	54.86

Source: National Science Foundation

Table B-12. Number and percent of the 333 responding firms established between 1972 and 1976, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	307	92.19	102	30.63	93	27.92	195	58.55
Providing competitive salaries and fringe benefits	305	91.59	98	29.42	113	33.93	211	63.36
Maintaining adequate R&D levels	299	89.78	131	39.33	101	30.33	232	69.66
Undertaking high-risk R&D projects	298	89.48	133	39.93	62	18.61	195	58.55
Purchasing capital equipment	306	91.89	99	29.72	105	31.53	204	61.26
Obtaining venture and/or working capital	317	95.19	183	54.95	76	22.82	259	77.77
Patenting and licensing	295	88.58	36	10.81	63	18.91	99	29.72
Government procurement regulations	308	92.49	154	46.24	66	19.81	220	66.06
Other government regulations	299	89.78	128	38.43	96	28.82	224	67.26
Transition from R&D to market	296	88.88	100	30.03	78	23.42	178	53.45
Government/industry communication	301	90.39	80	24.02	104	31.23	184	55.25

Source: National Science Foundation

Table B-13. Number and percent of the 43 responding firms established in 1976, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	39	90.69	8	18.60	12	27.90	20	46.51
Providing competitive salaries and fringe benefits	305	91.59	98	29.42	113	33.93	211	63.36
Maintaining adequate R&D levels	299	89.78	131	39.33	101	30.33	232	69.66
Undertaking high-risk R&D projects	298	89.48	133	39.93	62	18.61	195	58.55
Purchasing capital equipment	306	91.89	99	29.72	105	31.53	204	61.26
Obtaining venture and/or working capital	317	95.19	183	54.95	76	22.82	259	77.77
Patenting and licensing	295	88.58	36	10.81	63	18.91	99	29.72
Government procurement regulations	308	92.49	154	46.24	66	19.81	220	66.06
Other government regulations	299	89.78	128	38.43	96	28.82	224	67.26
Transition from R&D to market	296	88.88	100	30.03	78	23.42	178	53.45
Government/industry communication	301	90.39	80	24.02	104	31.23	184	55.25

Source: National Science Foundation

Table B-14. Number and percent of the 530 responding manufacturing firms, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	509	96.03	199	37.54	188	35.47	387	73.01
Providing competitive salaries and fringe benefits	509	95.66	184	34.71	217	40.94	401	75.66
Maintaining adequate R&D levels	508	95.84	219	41.32	183	34.52	402	75.84
Undertaking high-risk R&D projects	487	91.88	224	42.26	91	17.16	315	59.43
Purchasing capital equipment	499	94.15	137	25.84	230	43.39	367	69.24
Obtaining venture and/or working capital	502	94.71	234	44.15	105	19.81	339	63.96
Patenting and licensing	496	93.58	46	8.67	119	22.45	165	31.13
Government procurement regulations	489	92.26	157	29.62	136	25.66	293	55.28
Other government regulations	498	92.07	222	41.88	135	25.47	357	67.35
Transition from R&D to market	491	92.64	183	34.52	174	32.83	357	67.35
Government/industry communication	470	88.67	109	20.56	165	31.13	274	51.69

Source: National Science Foundation

Table B-15. Number and percent of the 702 responding nonmanufacturing firms, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	641	91.31	215	30.62	197	28.06	412	58.68
Providing competitive salaries and fringe benefits	647	92.16	226	32.19	226	32.19	452	64.38
Maintaining adequate R&D levels	619	88.17	239	34.04	205	29.20	444	63.24
Undertaking high-risk R&D projects	616	87.74	219	31.19	133	18.94	352	50.14
Purchasing capital equipment	643	91.59	186	26.49	206	29.34	392	55.84
Obtaining venture and/or working capital	653	93.01	314	44.72	162	23.07	476	67.80
Patenting and licensing	609	86.75	83	11.82	114	16.23	197	28.06
Government procurement regulations	643	91.59	334	47.57	139	19.80	473	67.37
Other government regulations	634	90.31	276	39.31	186	26.49	462	65.81
Transition from R&D to market	602	85.75	175	24.92	156	22.22	331	47.15
Government/industry communication	619	88.17	193	27.49	185	26.35	378	53.84

Source: National Science Foundation

Table B-16. Number and percent of the 57 responding manufacturers of chemicals and allied products, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	57	100.00	23	40.35	18	31.57	41	71.92
Providing competitive salaries and fringe benefits	56	98.24	22	38.59	19	33.33	41	71.92
Maintaining adequate R&D levels	57	100.00	27	47.36	14	24.56	41	71.92
Undertaking high-risk R&D projects	53	92.98	27	47.36	5	8.77	32	56.14
Purchasing capital equipment	55	96.49	13	22.80	28	49.12	41	71.92
Obtaining venture and/or working capital	56	98.24	20	35.08	14	24.56	34	59.64
Patenting and licensing	56	98.24	8	14.03	16	28.07	24	42.10
Government procurement regulations	51	89.47	18	31.57	12	21.05	30	52.63
Other government regulations	55	96.49	36	63.15	12	21.05	48	84.21
Transition from R&D to market	54	94.73	23	40.35	18	31.57	41	71.92
Government/industry communication	53	92.98	13	22.80	19	33.33	32	56.14

Source: National Science Foundation

Table B-17. Number and percent of the 56 responding manufacturers of fabricated metal products, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	52	92.85	24	42.85	15	26.78	39	69.64
Providing competitive salaries and fringe benefits	52	92.85	21	37.50	25	44.64	46	82.14
Maintaining adequate R&D levels	51	91.07	17	30.35	18	32.14	35	62.50
Undertaking high-risk R&D projects	51	91.07	16	28.57	12	21.42	28	50.00
Purchasing capital equipment	52	92.85	19	33.92	20	35.71	39	69.64
Obtaining venture and/or working capital	53	94.64	30	53.57	10	17.85	40	71.42
Patenting and licensing	53	94.64	8	14.28	17	30.35	25	44.64
Government procurement regulations	53	94.64	17	30.35	17	30.35	34	60.71
Other government regulations	52	92.85	22	39.28	15	26.78	37	66.07
Transition from R&D to market	51	91.07	12	21.42	20	35.71	32	57.14
Government/industry communication	51	91.07	13	23.21	19	33.92	32	57.14

Source: National Science Foundation

Table B-18. Number and percent of the 55 responding manufacturers of nonelectrical machinery, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	52	94.54	24	43.63	16	29.09	40	72.72
Providing competitive salaries and fringe benefits	53	96.36	19	34.54	27	49.09	46	83.63
Maintaining adequate R&D levels	51	92.72	31	56.36	13	23.63	44	80.00
Undertaking high-risk R&D projects	50	90.90	29	52.72	9	16.36	38	69.09
Purchasing capital equipment	51	92.72	19	34.54	16	29.09	35	63.63
Obtaining venture and/or working capital	52	94.54	22	40.00	6	10.90	28	50.90
Patenting and licensing	51	92.72	1	1.81	13	23.63	14	25.45
Government procurement regulations	52	94.54	12	21.81	10	18.18	22	40.00
Other government regulations	50	90.90	20	36.36	8	14.54	28	50.90
Transition from R&D to market	50	90.90	16	29.09	22	40.00	38	69.09
Government/industry communication	48	87.27	11	20.00	13	23.63	24	43.63

Source: National Science Foundation

Table B-19. Number and percent of the 136 responding manufacturers of electrical machinery, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	129	94.85	57	41.91	48	35.29	105	77.20
Providing competitive salaries and fringe benefits	129	94.85	50	36.76	52	38.23	102	75.00
Maintaining adequate R&D levels	130	95.58	54	39.70	53	38.97	107	78.67
Undertaking high-risk R&D projects	121	88.97	59	43.38	20	14.70	79	58.08
Purchasing capital equipment	128	94.11	35	25.73	60	44.11	95	69.85
Obtaining venture and/or working capital	128	94.11	55	40.44	32	23.52	87	63.97
Patenting and licensing	126	92.64	8	5.88	28	20.58	36	26.47
Government procurement regulations	123	90.44	46	33.82	38	27.94	84	61.76
Other government regulations	122	89.70	52	38.23	45	33.08	97	71.32
Transition from R&D to market	125	91.91	51	37.50	46	33.82	97	71.32
Government/industry communication	120	88.23	33	24.26	37	27.20	70	51.47

Source: National Science Foundation

Table B-20. Number and percent of the 153 responding manufacturers of instruments, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	149	97.38	48	31.37	61	39.86	109	71.24
Providing competitive salaries and fringe benefits	148	96.73	45	29.41	69	45.09	114	74.50
Maintaining adequate R&D levels	149	97.38	57	37.25	62	40.52	119	77.77
Undertaking high-risk R&D projects	144	94.11	59	38.56	37	24.18	96	62.74
Purchasing capital equipment	144	94.11	29	18.95	72	47.05	101	66.01
Obtaining venture and/or working capital	148	96.73	80	52.28	24	15.68	104	67.97
Patenting and licensing	144	94.11	13	8.49	34	22.22	47	30.71
Government procurement regulations	147	96.07	42	27.45	42	27.45	84	54.90
Other government regulations	143	93.46	58	37.90	39	25.49	97	63.39
Transition from R&D to market	145	94.77	58	37.90	48	31.37	106	69.28
Government/industry communication	137	89.54	24	15.68	47	30.71	71	46.40

Source: National Science Foundation

Table B-21. Number and percent of the 342 responding R&D laboratories, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	317	92.69	102	29.82	106	30.99	208	60.81
Providing competitive salaries and fringe benefits	323	94.44	108	31.57	125	36.54	233	68.12
Maintaining adequate R&D levels	305	89.18	124	36.25	91	26.60	215	62.86
Undertaking high-risk R&D projects	306	89.47	114	33.33	73	21.34	187	54.67
Purchasing capital equipment	325	95.02	100	29.23	11	32.45	211	61.69
Obtaining venture and/or working capital	327	95.61	148	42.27	83	24.26	231	67.54
Patenting and licensing	310	90.64	42	12.28	63	18.42	105	30.70
Government procurement regulations	314	91.81	134	39.18	99	28.94	233	68.12
Other government regulations	320	93.56	164	47.95	79	23.09	243	71.05
Transition from R&D to market	300	87.71	100	29.23	79	23.09	179	52.33
Government/industry communication	309	90.35	100	29.23	92	26.90	192	56.14

Source: National Science Foundation

Table B-22. Number and percent of the 139 responding business-service firms, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	126	90.64	44	31.65	33	23.74	77	55.39
Providing competitive salaries and fringe benefits	126	90.64	43	30.93	40	28.77	83	59.71
Maintaining adequate R&D levels	121	87.05	36	25.89	42	30.21	78	56.11
Undertaking high-risk R&D projects	121	87.05	42	30.21	20	14.38	62	44.60
Purchasing capital equipment	124	89.20	28	20.14	35	25.17	63	45.32
Obtaining venture and/or working capital	129	92.80	64	46.04	29	20.86	93	66.90
Patenting and licensing	114	82.01	11	7.91	19	13.66	30	21.58
Government procurement regulations	129	92.80	75	53.95	20	14.38	95	68.34
Other government regulations	125	89.92	48	34.53	41	29.49	89	64.02
Transition from R&D to market	120	86.33	18	12.94	38	27.33	56	40.28
Government/industry communication	122	87.76	33	23.74	40	28.77	73	52.51

Source: National Science Foundation

Table B-23. Number and percent of the 156 responding engineering-service firms, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	138	88.46	51	32.69	46	29.48	97	62.17
Providing competitive salaries and fringe benefits	138	88.46	57	36.53	44	28.20	101	64.74
Maintaining adequate R&D levels	133	85.25	58	37.17	46	29.48	104	66.66
Undertaking high-risk R&D projects	132	84.61	43	27.56	27	17.30	70	44.87
Purchasing capital equipment	135	86.53	38	24.25	40	25.64	78	50.00
Obtaining venture and/or working capital	137	87.82	72	46.15	31	19.87	103	66.02
Patenting and licensing	128	82.05	23	14.74	21	13.46	44	28.20
Government procurement regulations	136	87.17	67	42.94	31	19.87	98	62.82
Other government regulations	135	86.53	61	39.10	35	22.43	96	61.53
Transition from R&D to market	127	81.41	35	22.48	29	18.58	64	41.02
Government/industry communication	130	83.33	44	28.20	38	24.35	82	42.56

Source: National Science Foundation

Table B-24. Number and percent of the 172 responding manufacturers employing 1 to 19 people, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	159	92.44	51	29.65	56	32.55	107	62.20
Providing competitive salaries and fringe benefits	158	91.86	59	34.30	68	39.53	127	73.83
Maintaining adequate R&D levels	162	94.18	68	39.53	57	33.13	125	72.67
Undertaking high-risk R&D projects	156	90.69	67	38.95	33	18.18		58.13
Purchasing capital equipment	155	90.11	52	30.23	68	39.53	120	69.76
Obtaining venture and/or working capital	160	93.02	96	55.81	26	15.11	122	70.93
Patenting and licensing	154	89.53	13	7.55	34	19.76	47	27.32
Government procurement regulations	156	90.69	52	30.23	35	20.34	87	50.58
Other government regulations	155	90.11	65	37.79	39	22.67	104	60.46
Transition from R&D to market	157	91.27	58	33.72	47	27.32	105	61.04
Government/industry communication	151	87.79	28	16.27	52	30.23	80	46.51

Source: National Science Foundation

Table B-25. Number and percent of the 240 responding manufacturers employing 20 to 99 people, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	236	93.33	98	40.83	85	35.41	183	76.25
Providing competitive salaries and fringe benefits	235	97.91	90	37.50	96	40.00	186	77.50
Maintaining adequate R&D levels	234	97.50	97	40.41	89	37.08	186	77.50
Undertaking high-risk R&D projects	222	92.50	105	43.75	43	17.91	148	61.66
Purchasing capital equipment	230	95.83	57	23.75	106	44.16	163	67.91
Obtaining venture and/or working capital	231	96.25	104	43.33	54	22.50	158	65.83
Patenting and licensing	231	96.25	24	10.00	62	25.83	86	35.83
Government procurement regulations	227	94.58	72	30.00	66	27.50	138	57.50
Other government regulations	223	92.91	102	42.50	56	23.33	158	65.83
Transition from R&D to market	228	95.00	78	32.50	87	36.25	165	68.75
Government/industry communication	217	90.41	50	20.83	78	32.50	128	53.33

Source: National Science Foundation

Table B-26. Number and percent of the 118 responding manufacturers employing 100 to 499 people, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	dium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	114	96.6	50	42.4	47	39.8	97	82.2
Providing competitive salaries and fringe benefits	114	96.6	35	29.7	53	44.9	88	74.6
Maintaining adequate R&D levels	112	94.9	54	45.8	37	31.4	91	77.1
Undertaking high-risk R&D projects	109	92.4	52	44.1	15	12.7	67	56.8
Purchasing capital equipment	114	96.6	28	23.7	56	47.5	84	71.2
Obtaining venture and/or working capital	111	94.1	34	28.8	25	21.2	59	50.0
Patenting and licensing	111	94.1	9	7.6	23	19.5	32	27.1
Government procurement regulations	106	89.8	33	28.0	35	29.7	68	57.6
Other government regulations	110	93.2	55	46.6	40	33.9	95	80.5
Transition from R&D to market	106	89.8	47	39.8	40	33.9	87	73.7
Government/industry communication	102	86.4	31	26.3	35	29.7	66	55.9

Source: National Science Foundation

Table B-27. Number and percent of the 515 responding nonmanufacturers employing 1 to 19 people, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	460	89.32	141	27.37	133	25.82	274	53.20
Providing competitive salaries and fringe benefits	466	90.48	156	30.29	154	29.90	310	60.19
Maintaining adequate R&D levels	443	86.01	181	35.14	135	26.21	316	61.35
Undertaking high-risk R&D projects	441	85.63	162	31.45	94	18.25	256	49.70
Purchasing capital equipment	465	90.29	140	27.18	15	29.90	294	57.08
Obtaining venture and/or working capital	473	91.84	243	47.18	108	20.97	351	68.15
Patenting and licensing	433	84.07	61	11.84	89	17.28	150	29.12
Government procurement regulations	463	89.90	247	47.96	89	17.28	336	65.24
Other government regulations	455	88.34	195	37.86	128	24.85	323	62.71
Transition from R&D to market	434	84.27	132	25.63	114	22.13	246	47.76
Government/industry communication	446	86.60	154	29.90	127	24.66	281	54.56

Source: National Science Foundation

Table B-28. Number and percent of the 137 responding nonmanufacturers employing 20 to 49 people, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	132	96.35	57	41.60	44	32.11	101	73.72
Providing competitive salaries and fringe benefits	132	96.35	52	37.95	53	38.68	105	76.64
Maintaining adequate R&D levels	128	93.43	42	30.65	53	38.68	95	69.34
Undertaking high-risk R&D projects	128	93.43	38	27.73	33	24.08	71	51.82
Purchasing capital equipment	130	94.89	35	25.54	36	26.27	71	51.82
Obtaining venture and/or working capital	132	96.35	54	39.41	40	29.19	94	68.61
Patenting and licensing	130	94.89	15	10.94	21	15.32	36	26.27
Government procurement regulations	131	95.62	62	45.25	40	29.19	102	74.45
Other government regulations	131	95.62	60	43.79	41	29.92	101	73.72
Transition from R&D to market	123	89.78	32	23.35	28	20.43	60	43.79
Government/industry communication	127	92.70	32	23.25	40	29.19	72	52.55

Source: National Science Foundation

Table B-29. Number and percent of the 50 responding nonmanufacturers employing 50 to 99 people, by problem area

Problem areas	Number of responding firms	Percent	High	Percent	Medium	Percent	High plus medium	Percent
Attracting and keeping necessary personnel	49	98.00	17	34.00	20	40.00	37	74.00
Providing competitive salaries and fringe benefits	49	98.00	18	36.00	19	38.00	37	74.00
Maintaining adequate R&D levels	48	96.00	16	32.00	17	34.00	33	66.00
Undertaking high-risk R&D projects	47	94.00	19	38.00	6	12.00	25	50.00
Purchasing capital equipment	48	96.00	11	22.00	16	32.00	27	54.00
Obtaining venture and/or working capital	48	96.00	17	34.00	14	28.00	31	62.00
Patenting and licensing	46	92.00	7	14.00	4	8.00	11	22.00
Government procurement regulations	49	98.00	25	50.00	10	20.00	35	70.00
Other government regulations	48	96.00	21	42.00	17	34.00	38	76.00
Transition from R&D to market	45	90.00	11	22.00	14	28.00	25	50.00
Government/industry communication	46	92.00	7	14.00	18	36.00	25	50.00

Source: National Science Foundation

appendix c

reproduction of survey instruments

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NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

OFFICE OF THE DIRECTOR

September 1, 1977

Gentlemen:

The National Science Foundation requests the cooperation of your company in completing the enclosed questionnaire relating to the problems of small companies engaged in research and development.

As you know, such companies traditionally play a significant role in the innovation process and therefore in the well-being of American industry in general. This study is prompted both by the growing concern among Federal officials over the effects of recent economic fluctuations on small business and by an expressed interest on the part of small firms in such an analysis. In this survey, we are seeking information that will (1) help us identify and assess recent changes in the economic status of the small R&D-oriented firm, (2) disclose the reasons behind these changes, and (3) provide measures that might be taken to assure more effectively the continued viability of this important segment of American industry. The Foundation regards financial data requested by this survey as privileged and confidential. These data are solicited for statistical purposes only. After this survey is completed, we will analyze the results and use them as a basis for developing an in-depth study of those problem areas which appear most troublesome.

If you have any questions regarding this report, please contact Mr. Thomas J. Hogan, Study Director, Industry Studies Group, Division of Science Resources Studies, National Science Foundation, Washington, D.C. 20550 (Area Code 202, 634-4648). We appreciate your participation in this survey, and we will send your company a copy of the published report summarizing the results of the study.

Sincerely yours,

Richard C. Atkinson
Director

Enclosure

OMB No. 99-S77006
Approval Expires December 1977

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

SURVEY OF RESEARCH AND DEVELOPMENT IN SMALL COMPANIES

RETURN IN 30 DAYS TO:	NAME AND ADDRESS OF COMPANY:
National Science Foundation **Industry Studies Group, DSRS** **1800 G Street, N.W., Room L-602** **Washington, D.C. 20550**	

PRIVACY ACT NOTICE

This information is solicited under the authority of the National Science Foundation Act of 1950, as amended. All information you provide will be used for statistical purposes only. Your response is entirely voluntary and your failure to provide some or all of the information will in no way adversely affect your firm.

GENERAL INSTRUCTIONS

- Please complete and return this form in the envelope provided within 30 days. Retain the file copy for your records.
- This report should cover your entire company, including all subsidiaries and affiliates, unless otherwise designated.
- The figures reported should cover calendar years wherever possible.
- Reasonably accurate estimates are acceptable.
- **Read detailed instructions before completing form.**

Item 1. Has your company ever conducted research and development or purchased such services?

1201	Yes		If you answered "no" skip to Item 12.
1202	No		

Item 2. In what year did your company begin operations?

1301 ____

Item 3. What is your company's current form of ownership? (Check one)

1401	Sole proprietorship
1402	Partnership
1403	Public corporation
1404	Private corporation
1405	Wholly owned subsidiary
1406	Other (specify)

Item 4a. Use SIC codes to list principal products manufactured by company. (See Instructions)		Item 4b. Use SIC codes to list principal services provided by company. (See Instructions)	
1501		1551	
1502		1552	
1503		1553	
1504		1554	
1505		1555	

Item 5. Total employment of company, by major location. (Locations employing less than 10 percent of company total should be combined under "All other locations.") (For New England locations, only list city or town rather than county.)

	County and State [1]	1976 Employment [2]	1974 Employment [3]	1972 Employment [4]
160				
161				
162				
163				
164	All other locations			
165	TOTAL			

CONFIDENTIALITY. The Foundation regards financial data requested under items 6, 7, and 8 as privileged and confidential. These data are solicited for statistical purposes.

Item 6. Net sales and receipts (thousands of dollars)

		1976 [1]	1974 [2]	1972 [3]
	NET SALES			
170	To the Federal Government			
171	Other			
172	Total net sales			
	RECEIPTS			
173	Revenues from royalties and licensing			
174	Other			
175	Total receipts			
176	Total net sales and receipts			
177	*Percent of net sales accounted for by manufacturing*	%	%	%

Item 7. Profits and/or loss					
	180	Pretax profit (loss)			
	181	After-tax profit (loss)			
Item 8. Research and development expenditures, by source of funds.					
	190	Company funds for R&D			
	191	Federal funds for R&D			
	192	State government funds for R&D			
	193	Other funds for R&D			
	194	Total R&D funds			
	195	R&D purchases from outside the company			

Item 9. Problem areas. Please rate each of the following areas as "high," "medium," or "low" concern to your company and briefly describe in item 10 the most significant of these areas and the measures your company has undertaken to remedy them.

		AREAS	HIGH [1]	MEDIUM [2]	LOW [3]
	200	Attracting and keeping necessary personnel			
	201	Providing competitive salaries and fringe benefits			
	202	Maintaining adequate R&D levels			
	203	Undertaking high-risk R&D projects			
	204	Purchasing capital equipment			
	205	Obtaining venture and/or working capital			
	206	Patenting and licensing			
	207	Government procurement regulations			
	208	Other Government regulations			
	209	Transition from R&D to market			
	210	Government/industry communication			
	211	Other (specify)			
	212				
	213				

29

Item 10. Specify comments related to item 9, if any.

Item 11. Any other comments? Specify.

Item 12. Name of person completing questionnaire:	
NAME	TELEPHONE NO. ( )
TITLE	DATE

NATIONAL SCIENCE FOUNDATION
Washington, D.C. 20550

SURVEY OF RESEARCH AND DEVELOPMENT IN SMALL COMPANIES

Detailed Instructions and Definitions

Item 1—Research and Development. Includes basic and applied research in the sciences (including medicine) and in engineering, and design and development of prototypes and processes. Does not include quality control, routine product testing, market research, sales promotion, sales service, research in the social sciences or psychology, or other nontechnological activities or technical service.

If your company has ever conducted or purchased research and development, please answer "yes" to this question.

Item 3. Sole proprietorship, partnership, publicly held corporation, privately held corporation, wholly owned subsidiary of another company (specify name and address in item 11), etc.

Item 4a. Using the 3-digit SIC codes below, list, in order of sales volume, the principal products manufactured by your company; e.g., electronic components, drugs and medicines, photographic equipment, etc.

Item 4b. Using the SIC codes below, list, in order of sales volume, the principal services provided by your company; e.g., agricultural services, telephone communication, R&D laboratories. If listing code 7391, please place primary field of research and development in parentheses.

Item 5. Please list the total employment of your company for each location which accounts for approximately 10 percent or more of total employment. Sales offices and distribution centers should be included under "all other locations." New England locations should be identified by town or city rather than by county.

Item 6. Net sales to the Federal Government should include the value of sales on R&D contracts and subcontracts as well as own procurement contracts and subcontracts.

Item 8. Company-funded research performance within the company. Federal funds for research and development include the cost of work done on R&D contracts or subcontracts and R&D portions of procurement contracts and subcontracts. To avoid duplication, do not include here or elsewhere in the report R&D contracts and portions of procurement contracts that you subcontract to other R&D organizations. Other funds for research and development include the cost of research and development performed within the company and sponsored by other than Federal or State governments.

R&D purchases from outside the company include the direct purchase of research and development from other organizations.

STANDARD INDUSTRIAL CLASSIFICATION

Manufacturing Group

20 Food and Kindred Products

- 201 Meat products
- 202 Dairy products
- 203 Canned and preserved fruits and vegetables
- 204 Grain mill products
- 205 Bakery products
- 206 Sugar and confectionery products
- 207 Fats and oils
- 208 Beverages
- 209 Miscellaneous food preparations and kindred products

21 Tobacco Manufactures

- 211 Cigarettes
- 212 Cigars
- 213 Tobacco (chewing and smoking) and snuff
- 214 Tobacco stemming and redrying

22 Textile Mill Products

- 221 Broad woven fabric mills, cotton
- 222 Broad woven fabric mills, manmade fiber and silk
- 223 Broad woven fabric mills, wool (including dyeing and finishing)
- 224 Narrow fabrics and other smallwares mills: cotton, wool, silk, and manmade fiber
- 225 Knitting mills
- 226 Dyeing and finishing textiles, except wool fabrics and knit goods
- 227 Floor covering mills
- 228 Yarn and thread mills
- 229 Miscellaneous textile goods

23 Apparel and Other Finished Products

- 231 Men's, youths', and boys' suits, coats, and overcoats
- 232 Men's, youths', and boys' furnishings, work clothing, and allied garments
- 233 Women's, misses', and juniors' outerwear
- 234 Women's, misses', children's, and infants' undergarments
- 235 Hats, caps, and millinery
- 236 Girls', children's, and infants' outerwear
- 237 Fur goods
- 238 Miscellaneous apparel and accessories
- 239 Miscellaneous fabricated textile products

24 Lumber and Wood Products, Except Furniture

- 241 Logging camps and logging contractors
- 242 Sawmills and planning mills
- 243 Millwork, veneer, plywood, and structural wood members
- 244 Wood containers
- 245 Wood buildings and mobile homes
- 249 Miscellaneous wood products

25 Furniture and Fixtures

- 251 Household furniture
- 252 Office furniture
- 253 Public building and related furniture
- 254 Partitions, shelving, lockers, and office and store fixtures
- 259 Miscellaneous furniture and fixtures

26 Paper and Allied Products

- 261 Pulp mills
- 262 Paper mills, except building paper mills
- 263 Paperboard mills
- 264 Converted paper and paperboard products, except containers and boxes
- 265 Paperboard containers and boxes
- 266 Building paper and building board mills

27 Printing, Publishing, and Allied Industries

- 271 Newspapers: publishing, publishing and printing
- 272 Periodicals: publishing, publishing and printing
- 273 Books
- 274 Miscellaneous publishing
- 275 Commercial printing
- 276 Manifold business forms
- 277 Greeting card publishing
- 278 Blankbooks, looseleaf binders, and bookbinding and related work
- 279 Service and industries for the printing trade

28 Chemicals and Allied Products

- 281 Industrial inorganic chemicals
- 282 Plastics materials and synthetic resins, synthetic rubber, synthetic and other manmade fibers, except glass
- 283 Drugs
- 284 Soap, detergents, and cleaning preparations, perfumes, cosmetics, and other toilet preparations
- 285 Paints, varnishes, lacquers, enamels, and allied products
- 286 Industrial organic chemicals
- 287 Agricultural chemicals
- 289 Miscellaneous chemical products

29 Petroleum Refining and Related Industries

- 291 Petroleum refining
- 295 Paving and roofing materials
- 299 Miscellaneous products of petroleum and coal

30 Rubber and Miscellaneous Plastics Products

- 301 Tires and inner tubes
- 302 Rubber and plastics footwear
- 303 Reclaimed rubber

Rubber, etc.—Con.

304 Rubber and plastics hose and belting
306 Fabricated rubber products, not elsewhere classified
307 Miscellaneous plastics products

31 Leather and Leather Products

311 Leather tanning and finishing
313 Boot and shoe cut stock and findings
314 Footwear, except rubber
315 Leather gloves and mittens
316 Luggage
317 Handbags and other personal leather goods
319 Leather goods, not elsewhere classified

32 Stone, Clay, Glass, and Concrete Products

321 Flat glass
322 Glass and glassware, pressed or blown
323 Glass products, made of purchased glass
324 Cement, hydraulic
325 Structural clay products
326 Pottery and related products
327 Concrete, gypsum, and plaster products
328 Cut stone and stone products
329 Abrasive asbestos, and miscellaneous nonmetallic mineral products

33 Primary Metal Industries

331 Blast furnaces, steel works, and rolling and finishing mills
332 Iron and steel foundries
333 Primary smelting and refining of nonferrous metals
334 Secondary smelting and refining of nonferrous metals
335 Rolling, drawing, and extruding of nonferrous metals
336 Nonferrous foundaries (castings)
339 Miscellaneous primary metal products

34 Fabricated Metal Products, Except Machinery and Transportation Equipment

341 Metal cans and shipping containers
342 Cutlery, hand tools, and general hardware
343 Heating equipment, except electric and warm air; and plumbing fixtures
344 Fabricated structural metal products
345 Screw machine products, and bolts, nuts, screws, rivets, and washers
346 Iron and steel forgings
347 Coating, engraving, and allied services
348 Ordnance and accessories, except vehicles and guided missiles
349 Miscellaneous fabricated metal products

35 Machinery, Except Electrical

351 Engines and turbines
352 Farm and garden machinery and equipment
353 Construction, mining, and materials handling machinery and equipment
354 Metalworking machinery and equipment
355 Special industry machinery, except metalworking machinery
356 General industrial machinery and equipment
357 Office, computing, and accounting machines
358 Refrigeration and service industry machinery
359 Miscellaneous machinery, except electrical

36 Electrical and Electronic Machinery, Equipment, and Supplies

361 Electrical transmission and distribution equipment
362 Electrical industrial apparatus
363 Household appliances
364 Electric lighting and wiring equipment
365 Radio and television receiving equipment, except communication types
366 Communication equipment
367 Electronic components and accessories
369 Miscellaneous electrical machinery, equipment, and supplies

37 Transportation Equipment

371 Motor vehicles and motor vehicle equipment
372 Aircraft and parts
373 Ship and boat building and repairing
374 Railroad equipment
375 Motorcycles, bicycles, and parts
376 Guided missiles and space vehicles and parts
379 Miscellaneous transportation equipment

38 Measuring, Analyzing, and Controlling Instruments; Photographic, Medical, and Optical Goods; Watches and Clocks

381 Engineering, laboratory, scientific, and research instruments and associated equipment
382 Measuring and controlling instruments
383 Optical instruments and lenses
384 Surgical, medical, and dental instruments and supplies
385 Ophthalmic goods
386 Photographic equipment and supplies
387 Watches, clocks, clockwork operated devices, and parts

39 Miscellaneous Manufacturing Industries

391 Jewelry, silverware, and plated ware
393 Musical instruments
394 Toys and amusement, sporting, and athletic goods
395 Pens, pencils, and other office and artists' materials
396 Costume jewelry, costume novelties, buttons, and miscellaneous notions, except precious metal
399 Miscellaneous manufacturing industries

Nonmanufacturing Group

07 Agricultural Services

- 071 Soil preparation services
- 072 Crop services
- 074 Veterinary services
- 075 Animal services, except veterinary
- 076 Farm labor and management services
- 078 Landscape and horticultural services

08 Forestry

- 081 Timber tracts
- 082 Forest nurseries and tree seed gathering and extracting
- 084 Gathering of miscellaneous forest products, except tree seeds
- 085 Forestry services

10 Metal Mining

- 101 Iron ores
- 102 Copper ores
- 103 Lead and zinc ores
- 104 Gold and silver ores
- 105 Bauxite and other aluminum ores
- 106 Ferroalloy ores, except vanadium
- 108 Metal mining services
- 109 Miscellaneous metal ores

11 Anthracite Mining

12 Bituminous Coal and Lignite Mining

13 Oil and Gas Extraction

- 131 Crude petroleum and natural gas
- 132 Natural gas liquids
- 138 Oil and gas field services

14 Mining and Quarrying of Nonmetallic Minerals, except Fuels

- 141 Dimension stone
- 142 Crushed and broken stone, including riprap
- 144 Sand and gravel
- 145 Clay, ceramic, and refractory minerals
- 147 Chemical and fertilizer mineral mining
- 148 Nonmetallic minerals (except fuels) services
- 149 Miscellaneous nonmetallic minerals, except fuels

15 Construction

41 Local and Suburban Transit and Interurban Highway Passenger Transportation

42 Motor Freight Transportation and Warehousing

44 Water Transportation

45 Transportation by Air

46 Pipelines, except Natural Gas

47 Transportation Services

48 Communication

- 481 Telephone communciation
- 482 Telegraph communication
- 483 Television and radio broadcasting
- 489 Communication services, not elsewhere classified

49 Electric, Gas and Sanitary Services

- 491 Electric services
- 492 Gas production and distribution
- 493 Combination electric and gas and other utility services
- 494 Water supply
- 495 Sanitary services
- 496 Steam supply
- 497 Irrigation systems

50 Wholesale Trade

52 Retail Trade

60 Banking

61 Credit Agencies other than Banks

62 Security and Commodity Brokers, Dealers, Exchanges, and Services

63 Insurance

65 Real Estate

66 Combinations of Real Estate, Insurance, Loans, Law Offices

67 Holding and Other Investment Offices

739 Miscellaneous Business Services

- 7391 Research and development laboratories (please specify type of research and development performed)
- 7392 Management, consulting, and public relations services
- 7393 Detective agencies and protective services
- 7394 Equipment rental and leasing services
- 7395 Photofinishing laboratories
- 7396 Trading stamp services
- 7397 Commercial testing laboratories
- 7399 Business services, not elsewhere classified

807 Medical and Dental Laboratories

891 Engineering, Architectural, and Surveying Services

other science resources publications

Science Resources Studies Highlights

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R&D Funds		
"National R&D Spending Expected to Approach $80 Billion in 1982"	81-314	-----
"R&D Expenditures Increased 3% in Real Terms at Universities and Colleges in FY 1979"	81-304	-----
"Federal Academic Science Support Rose by 13% in FY 1979"	81-303	-----
"Federal R&D Obligations Will Show Real Growth in 1981—Mostly From DOD Programs"	80-322	-----
"March Cutbacks in Federal Budget Leaves Strong Defense R&D Growth in 1981—Other Areas Lag"	80-319	-----
"National R&D Spending Expected to Reach $67 Billion in 1981"	80-310	-----
S/E Personnel		
"Engineering Colleges Report 10% of Faculty Positions Vacant in Fall 1980"	81-322	-----
"Trends in Science and Engineering Degrees, 1950 Through 1980"	81-320	-----
"Science and Engineering Faculty With Recent Doctorates Fell to One-Fifth of Total in 1980"	81-318	-----
"University S/E Faculty Spend One-Third of Professional Time in Research"	81-317	-----
"Academic Employment of Scientists and Engineers Increased 6% Between 1978 and 1980"	81-315	-----
"Employment Opportunities for Ph.D. Scientists and Engineers Shift From Academia to Industry"	81-312	-----
"Tenure Practices in Universities and 4-Year Colleges Affect Faculty Turnover"	81-300	-----

Detailed Statistical Tables

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